UNIVERSITI PUTRA MALAYSIA

FAT MIGRATION OF LAURIC AND NON-LAURIC FAT USED AS BASE FILLING CENTRE IN DARK CHOCOLATE AT DIFFERENT STORAGE TEMPERATURES

ABDELRAHIM ABDELBAGI ALI

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By

ABDELRAHIM ABDELBAGI ALI

Thesis Submitted in Fulfilment of the Requirement for the Degree of Doctor of Philosophy in the Faculty of Food Science and Biotechnology
Universiti Putra Malaysia

January 2001

DEDICATION

This thesis is dedicated to

my beloved wife Sana,

my children, Mohamad, Zeinab, Ali,

my affectionate parents, brothers and sisters,

for their patience, love and support.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for degree of Doctor of Philosophy

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Chairman: Professor Dr. Jinap Selamat

Faculty: Food Science and Biotechnology

The effects of migration of used filling fats palm kernel stearin (PKS), palm mid-fraction (PMF) and desiccated coconut (DCN) (66% coconut oil) on the physical and chemical characteristics of dark chocolate at different storage temperatures (18°C, 30°C and 35°C) were studied. Fat migration was stimulated in a system by using layers of cream filling and dark chocolates. Total fat content, trigacylglycerol (TAG), fatty acid composition (FAC), solid fat content (SFC), hardness, melting point (MP), polymorphic structure and bloom formation were determined, each week interval for eight weeks. The chocolate samples stored at 18°C showed post-hardening on storage and no indication of softening within two months of storage. There was no significant change in the melting point of chocolate layers (CB). The X-ray diffraction pattern showed that β polymorph dominates in chocolate layers during eight weeks of storage, and the chocolates withstand bloom up to 6 months storage. At 30°C, migration occurred rapidly, giving a

maximum effect in term of hardness, solid fat content, polymorphic structure, and the chocolate bloom after several weeks of storage. Complete deterioration occurred in all chocolate stored at 35°C at the first week of storage. Sensory evaluation indicated that DCN imparts a pleasant flavour to the chocolate. Fractionated PKS or PMF and DCN fillings will be useful if chocolate was stored at a relatively low temperature below 20°C. It can be concluded that a thickness of 3 mm of chocolate could be used for coating of PKS, PMF and PKS+DCN fillings at 18°C. However, at least a 6mm thickness of chocolate is required to coat PMF+DCN centre at 18°C storage.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

MIGRASI LEMAK OLEH MENTENGA-KERAS LAURIK DAN LEMAK BUKAN LAURIK YANG DIGUNAKAN SEBAGAI LAPISAN PENGISI TENGAH DI DACAM COKLAT HITAM PADA SUHU PENYIMPANAN YANG BERBEZA

Oleh

ABELRAHIM ABDELBAGI ALI

Januari 2001

Pengerusi: Profesor Jinap Selamat, Ph.D.

Fakulti: Sains Makanan dan Bioteknologi

Kesan migrasi lemak pengisi palm kernel stearin (PKS), palm mid fraction (PMF) dan kelapa parut (DCN) (66% minyak kelapa) ke atas sifat fizikal dan kimia coklat tanpa susu pada suhu penyimpanan yang berbeza (18°C, 30°C, dan 35°C) telah dikaji. Migrasi lemak digalakkan di dalam satu sistem yang menggunakan beberapa lapisan pengisi krim dan coklat tanpa susu. Jumlah lemak, triasylgliserol (TAG), komposisi asid lemak, lemak pejal, kekerasan, takat lebur, struktur polimorfik dan pembentukan bloom dikaji sekali seminggu, selama lapan minggu. Coklat yang disimpan pada suhu 18°C menunjukkan "post hardening" dan tiada kesan kelembutan setelah disimpan selama 2 bulan. Tiada perubahan yang ketara pada takat lebur lapisan coklat. Difraksi sinar-X menunjukkan bahawa polimof β adalah paling dominan pada lapisan coklat selepas penyimpanan selama 8 minggu dan tiada kesan bloom kelihatan

selama 6 bulan pertama penyimpanan. Pada suhu 30°C, migrasi berlaku dengan cepat mengakibatkan kesan yang maksimum pada kekerasan, jumlah lemak, struktur polimorfik dan bloom coklat setelah penyimpanan selama beberapa minggu. Kerosakan coklat yang disimpan pada 35°C terjadi pada minggu pertama penyimpanan. Penilaian deria rasa menunjukkan bahawa DCN mengakibatkan kerosakan pada citarasa sebenar coklat. PKS atau PMF yang difraksinasi dan DCN boleh bertahan lama apabila coklat disimpan pada suhu di bawah 20°C. Dengan demikian, dapat disimpulkan bahawa ketebalan coklat 3 mm boleh digunakan dalam proses peyalutan mengunakan pengisi PKS, PMF dan PKS+DCN. Sebaliknya, ketebalan coklat sekurang-kurangnya 6 mm diperlukan untuk penyalutan mengunakan pengisi PMF+DCN pada penyimpanan 18°C.

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I certify that an Examination Committee met on 17th January 2001 to conduct the final examination of Abdelrahim Abdelbagi Ali on his Doctor of Philosophy thesis entitled "Fat Migration of Lauric and Non–Lauric Fat Used as Base Filling Centre in Dark Chocolate at Different Storage Temperatures" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981.The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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I here by declare that the dissertation is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Putra Malaysia or other Institutions.

ABDELRAHIM ABDELBAGI ALI

Date 6-2-2001

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LIST OF ABBREVIATIONS

CB	cocoa butter
CBE	cocoa butter equivalent
CBS	cocoa butter substitute
CBX	cocoa butter extender
PKS	palm kernel stearin
FHPKO	fractionated hydrogenated palm kernel oil
PMF	palm mid-fraction
CNO	coconut oil
DCN	desiccated coconut
HPLC	high performance liquid chromatography
GC	gas chromatography
DSC	differential scanning calorimeter
NMR	nuclear magnetic resonance
SFC	solid fat content
SMI	specific migration index
LFC	liquid fat content
TFC	total fat content
RC	rate of change
MPOB	Malaysia Palm Oil Board
FAME	fatty acid methyl ester
FAC	Fatty acid composition

TFC	total fat content
mm	millimeter
MP	melting point
IV	Iodine value
TAG	triacylglycerol
POP	Palmitic-oleic-palmitic
POS	Palmitic-oleic-stearic
SOS	stearic-oleic-stearic
LLL	lauric-lauric-lauric
LLM	Lauric-lauric-myrstic